February 1962

EMO

NATIONAL DIGEST

The Case for Fallout Shelters

Casualties from Nuclear Weapons

Radioactive Contamination of the Food Chain

A Group Fallout Shelter

EMERGENCY MEASURES ORGANIZATION

THE EMO NATIONAL DIGEST

Published by the Emergency Measures Organization of the Privy Council Office

VOL. 2 NO. 1 FEBRUARY 1962.

TABLE OF CONTENTS

THE CASE FOR FALLOUT SHELTERS ..... NICHOLAS ROSA

CASUALTIES FROM NUCLEAR WEAPONS ..... F. C. PACE, M.D.

RADIOACTIVE CONTAMINATION OF THE FOOD CHAIN ..... B. B. MIGICOVSKY

A GROUP FALLOUT SHELTER ..... *A Report*

The EMO NATIONAL DIGEST is published bi-monthly to provide current information on a broad range of subjects dealing with civil emergency planning. The magazine is published in English and French and may be obtained by writing to the Emergency Measures Organization, Privy Council Office, East Block, Ottawa.

In addition to publishing articles which reflect Canadian Government policy the Digest may also publish articles by private individuals on subjects of current interest to the emergency measures programme. The views of these contributors are not necessarily subscribed to by the Federal Government.

Director: R. B. CURRY. *Editor:* A. B. STIRLING.

ROGER DUHAMEL, F.R.S.C.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1962

HIGHLIGHTS

In this issue of the *Digest* your attention is directed to an announcement appearing on the inside back cover concerning a new United States publication entitled *Fallout Protection.*

* * *

Your attention is also directed to *The Case for Fallout Shelters* by Nicholas Rosa. Mr. Rosa, who is Associate Editor of *Science World,* has written a very interesting and informative article.

* * *

The *Digest* would like to thank the owners of the group underground fallout shelter for their co-operation while preparing the photo story appearing in this issue. These four Ottawa families are among the steadily increasing number of Canadians who are making definite personal emergency preparations.

* * *

Canada pioneered research in the removal of Strontium 90 from milk. Three years ago, Dr. B. B. Migicovsky, a scientist on the staff of the Federal Agriculture Department's research branch, discovered a method of removing this long lasting contaminate. The United States Department of Agriculture became interested in this Canadian research and carried it through the pilot plant stage.

In this issue of the *Digest* Dr. Migicovsky explains his method under the heading "Radioactive Contamination of the Food Chain."

THE CASE FOR FALLOUT SHELTERS

by NICHOLAS A. ROSA

The following article first appeared in the December issue of THE REPORTER.

The author, Nicholas A. Rosa, graduated from Yale University as a Bachelor of Social Science and is now Associate Editor of SCIENCE WORLD.

Mr. Rosa uses a crisp and dramatic style to emphasize his strong convictions on the value of fallout shelters.

The DIGEST *would like to thank* THE REPORTER *and Mr. Rosa for their permission to reprint this interesting viewpoint.*

"NUCLEAR WAR is so colossal a sin that there is only one atonement: universal death."

No one is being quoted here. That is, I myself have not heard anyone state the proposition so boldly. And yet it seems to be held by quite a number of very serious people. They are well represented in the letters-to-the-editor columns. Or they write columns. They are vocal at cocktail parties when the subject of nuclear war comes up—as it will these days. They even have spokesmen in the pulpits.

The unspoken dictum has nothing to do with retaliation. It does not merely mean that a nuclear-armed aggressor must expect his own people to perish. Annihilation is demanded for the aggressor's victims as well. If nuclear war visits the world, all mankind deserves death. The children deserve death. If you argue against this awesome thesis, it is plain that you are not against nuclear war.

For these people, a fallout shelter, even to protect the children, is anathema. Every possible argument is brought to bear against it. It is un-Christian, it is an admission of failure in man's ability to get along with man. It is futile ("after two weeks, what?"). It provokes the enemy since it makes him think you are planning a nuclear war. A true peace lover will stay above ground and die with his neighbors, the way God meant him to.

You may be opposed to the idea of shelters, or you may still be undecided. No one, however, should take a stand on the subject without hearing the facts about radiation. It seems altogether likely that a minority of the casualties in a nuclear war would result from the immediate blast and heat effects of the bombs. Most fatalities would occur *later*, from the radiation effects of fallout dust streaming down the winds from the explosion sites. Lethal fallout streaks could stretch farther than five hundred miles. Radiation sickness is horrible, long-lasting even when fatal, and also completely degrading to human dignity. Few people, whether they are for or against fallout shelters, seem to be aware of these facts.

The nay-sayers have a point or two on their side. I am happy to hear their challenge of "After your two weeks in a shelter, what would you find when you emerged?" Granted, you would not find the neighborhood supermarket doing business as usual, wherever you were. And you would probably find yourself in a strangely ravaged landscape, with the trees dead or dying, practically all useful plants gone, and the soil already eroding—even if, in your area, people and buildings seemed untouched. These are possibilities to be faced by the public as well as civil-defense authorities, and they ought to be faced now.

After Armageddon

Let us place you, for a moment, in a hypothetical "survival situation" after the recommended two weeks. You might learn immediately that your shelter is still your home. You might be informed, by whatever official agencies were functioning, that the winds were redistributing the fallout. By that time most of its radioactivity would have decayed, but any concentrated drifts of fallout dust would tend to be quite "hot." Furthermore, the enemy could have reserved some of his nuclear capability for some kind of second strike, or a third, two weeks after the first.

For all survivors, there would be the problem of food and water. It need not be an insurmountable problem. Paradoxically, the more survivors there were —in any locality or over the country as a whole—the easier these problems would be to solve. Conversely, the fewer the survivors, the more difficult the problems.

Nuclear bombs would start firestorms wherever they exploded. The firestorms would destroy thousands of square miles of crops, forests, and watershed. Fallout would make many fields unusable for one to four or more growing seasons. This is because growing plants would tend to absorb and concentrate "hot" fallout materials from the soil. The initial loss of vegetation would result in extremely rapid erosion and silting up of reservoirs.

Some help might come from unexpected quarters. Surviving Congressmen might find themselves glad, for once, to see Argentine beef entering this country. Some of the "backward" nations might start an aid program to keep us alive.

However, the distribution of aid and the distribution of stockpiled food, medicines, and other needs would be difficult. Transportation and communications networks would have been disrupted. Some supplies, while easy to decontaminate, might thus be inaccessible for weeks.

This is where the importance of a larger number of survivors becomes evident. The more survivors, the more manpower available for restoring transportation and communications facilities, for decontamination work, for rebuilding police protection and other community services, and for aiding the sick and injured. A small number of survivors—say a few million, scattered over the entire country—would be capable of only a miserable and savage existence.

At first glance, this looks like a winning score for the nay-sayers. Fallout protection is one problem, but survival "afterwards" is a second problem. However, I do not think the second problem is any reason to decide to lie down and die, or to require the children to die—and of radiation sickness at that.

Many survivors of a nuclear war would find themselves living in an extremely harsh frontier world, at least for a time. Our forefathers lived on a frontier and laid the foundations of the better world we enjoy today. Cold, hunger, drought, fire, Indians, and disease were realities they accepted. They did not choose death or condemn their children to it. They not only kept the human spirit alive but lived all the more intensely for it.

Myths and Megatons

It is time, I think, to shatter a few old wives' tales about fallout and radiation. To begin with, radioactivity decays, and most radioactive isotopes are short lived. While the fallout problem in food would be grave after attack, it would not be for the reasons most commonly assumed. At the end of two weeks, the threat of true radiation sickness would have passed. (Of the two hundred-odd bomb products in fallout, most have such short half-lives that radiation would have fallen to "safe" or acceptable rates in a matter of days. Two weeks is a *maximum* time for the protection of most people.) However, there would be plenty of residual, long-lived fallout material to enter the soil, to be taken up by plants in the food chain, and eventually to enter the human system. Your child's *strontium-90 intake would then be much higher than it is now. His (and your) statistical chances of dying of leukemia would have increased. Everyone would gain a significant amount of carbon-14 in his tissues—including his reproductive cells. The result would be an increase in the number of children born with defects in future generations. This prospect of genetic damage is, of course, a compelling argument against nuclear war. Some people use it as an argument against survival. But where is the logic in arguing that hundreds of millions ought to die in our time because a few million people over the next thirty to three hundred generations might have defects?

I do not intend to minimize the difficulties of survival. My intent is to show that there are limits to the problems. You would not emerge from a shelter only to die of radiation sickness, contrary to the prevalent folklore. The shelter's function is to keep you safe during the short period when radiation sickness would be a direct threat. The entire world would suffer as a result of nuclear war, but the world would not be lost—contrary to the thesis of Nevil Schute's dramatic novel *On the Beach*.

However, few people harp on the *On the Beach* theme any more. The more common assertion is that all food remaining after a nuclear attack would be radioactive. This is simply not true. Canned food, or bottled or jarred or packaged food, would still be wholesome—although it might be best to rinse off the can stop before opening them.

Some of the fallout would be dissolved in most public drinking-water reservoirs. You would not be able to remove it by boiling or chlorination—radioactivity is not the same kind of thing as bacterial contamination. But distillation would remove it. So would water-softening techniques, equipment for which is already found in many homes. It would be safe, as a rule, to wash or bathe in water straight from any faucet—or from a river or from the sea.

Canned or packaged food in your pantry would be safe. Fallout would probably never have reached it.

* Editor's Note. Read Dr. Migicovsky's article page 15.

Nor would fallout have gotten into your refrigerator. The powerful gamma radiation from outdoors—your actual reason for taking shelter—might have killed you, but it could never make your food, furniture, or clothing radioactive. Post-nuclear living would be hard but the rebuilding could commence at once.

Preparation Is Not Provocation

By my seeming optimism I do not mean to imply that nuclear war is "practicable" or desirable. What I am saying is that the horrors of nuclear war, and the early difficulties attending survival, are no reason for the West to pine away and die right now. Or to surrender, for surrender itself could lead to nuclear death.

Even if both we and the Soviet Union were to give up our nuclear arms tomorrow, Communist China will have its own bombs sometime in the next decade. Then the shelter problem will be with us—and with the Russians and even the neutralists—all over again. The time to prepare for this development is now.

There is much to be done. Crop and forest seeds must be stored, as well as food, fuel, medicines, and tools. (Seeds have always been stored, on a relatively small scale, by lumbering interests against the outbreak of forest fires. Needless to say, lumbering interests are "against" forest fires, but value judgments have no effect on nature.) Food and medicine stockpiling must be carefully worked out. Supplies must not be concentrated on military reservations and in the hearts of possible target cities. Along with seeds, large soil samples and even hydroponic farming chemicals ought to be dispersed in stockpiles in order to ensure that certain types of seedlings could get a good start (this is something agricultural colleges can do *now,* in their deeper cellars). And some kind of practical shelter for livestock must be worked out.

Fallout shelters themselves are only a minimum; firestorm protection is needed too. Many fallout shelters that happened to be within a firestorm area would not afford survival—because the fires would use up all available oxygen quickly—unless they could be sealed and were equipped with a bottled oxygen supply. But fallout protection alone is better than nothing. There is no possible protection against a direct hit by a hydrogen bomb, and everyone ought to understand this. Many people who think fallout shelters are futile are actually confusing them with blast shelters. However, there is no way to predict where an enemy's direct hits would be placed. Anyone who did not die quickly in a blast or a firestorm would need fallout protection—and desperately.

How Your Children Would Die

The next several paragraphs are going to be grim. By way of preparation, let us acknowledge that it is only human to be against nuclear war. We are all against floods, too. But nobody imagines that by refusing to flee to higher ground, he will persuade a river to stay

away from his door. Nor does anyone say he would provoke the river by investing in a rowboat.

There are those who say, as we have all heard, that they would "take their chances above ground" in a nuclear war. Their avowed purpose is protest of some sort, and their motivations are noble. But you might as well protest the lightning, or fling sweet nonviolent reproach at a volcano. Apparently these people have no idea of what "taking chances" entails—no idea, that is, of the nature of radiation sickness. Otherwise there is no way to explain how clergymen, columnists, and cocktail-party pundits can campaign against the very idea of shelters.

Perhaps these people have overestimated the achievements of modern science. They seem to confuse fallout radiation with the "death ray" of science fiction. You know: this ray shines on you, and *zot*!—you're dead. They understand that you can't feel the radiation as it penetrates you: it's like the medical X-ray. This last part is true, but radiation, alas, does not kill you *zot*.

It is all very well to maintain that you "wouldn't want your children to live in a bombed-out world." In that case, you must be prepared for the manner in which your children would die, if they died from the fallout. They would not pass away in peace and undefiled. Depending on the dose of radiation, they would die slowly, in pain and agonizing sickness, over a period of weeks. If the dose were extremely intense, a failure of the delicate chemistry of the nervous system might mercifully bring on a heart attack or suffocation after thirty-six hours or so.

But the likelihood is that they would vomit incessantly, and suffer almost continuous bloody diarhea for days. Radiation damage to bone marrow destroys the body's ability to resist ordinary infection. They might—somehow—recover from intestinal symptoms only to die of staphylococcus invasion. If they survived exposure, it would take months for burns to scar over, hair to grow back, and inner tissues to regenerate.

Of course, these same things would be happening to you, since it is safe to assume that if your children lacked shelter, you would lack it too. If you all survived, your lives would have been shortened. Millions of your body cells would have been killed. Other cells would have been damaged and would fail to function properly. Everyone's chances of developing leukemia, bone cancer, or other radiation-caused illness after some lapse of time would be very high. If your children lived to reproducing age, they would undoubtedly pass on genetic mutations to their descendants. The mutations would show up in defects and deformities of one kind and degree or another.

Now, at least, you know how you would die if you decided to immolate yourself in order to protest man's inhumanity to men.

Obviously, radiation sickness is not a pleasant matter to contemplate. It is not a pleasant thing to describe. And sometimes describing it provokes weird responses: a fellow who was preaching nonviolence two minutes ago will declare he is going to keep a pistol and shoot his children, his wife, and himself the moment war should come.

A self-conscious purity seems to pervade at least some of the more vocal anti-shelterites. In fact, many of these people tend to be holier than thou. They like especially to harp on the "un-Christian" attitude of shelter owners who serve notice that they intend to keep their neighbours out.

Who Is My Neighbor?

This issue has been clouded by a lack of definition of the word "neighbors." Apparently, "neighbors" is taken to mean anybody and everybody. What about the marauder, the looter, the rapist, against whom one locks the door even in the most tranquil times? Such people might be abroad—literally in force, in packs and gangs—at the time one would be taking shelter. They would be making the rounds. Wherever they showed up, it might have been better for the women and children to have been vaporized in a fireball.

Any debate on the ethics of shelters was settled ages ago. Our best moral tradition—or any tradition—has a "lifeboat" ethic. The individual may volunteer to give up his place in a lifeboat to someone less fortunate—a commendable act. But our social ethic certainly does not require that anyone throw his own children out of the lifeboat. It has also conceded, to the officer in charge of a lifeboat, the right to keep the boat from being overloaded and swamped. The injunction to love thy neighbor as theyself does not imply that nobody should survive a shipwreck.

It is highly probable that most shelter owners would take some of their actual neighbors in if nuclear war came tonight. But I hope my own neighbors would have provided themselves with shelters. That would enable me to take in the passing motorist.

The Cathari of the late Middle Ages were Christians, all right, and their name proclaims that they were more "pure" than any other Christians. They regarded man's material nature, works, and needs as intrinsically evil. Significantly, the Cathari held that death is better than life.

Our present-day Cathari are entitled to their beliefs. If they wish to have death, and have it more abundantly, we ought to accord them our perfect tolerance. We might consider protecting their children—just as we insist that the children of other strict sects be vaccinated. But we need not keep any adult from dying of radiation sickness if he wants to.

There is probably little prospect of any great lemming-dash into the fallout. Few people will "want" radiation sickness once they have learned something about it.

Nevertheless, the counsels of our modern Cathari ought to be countered vigorously by more positive ideas until the American people are as adequately sheltered as the state of the art permits. Our traditional western concern has been with life. Let the Orient treat life cheaply. Let the Communists waste life wholesale, as a matter of policy, and find justification for wasting it. But this is not the way of the West. Our strivings have always been toward conserving life, preventing suffering, and alleviating ills. Unlike the various sects of Cathari throughout history, most westerners have not been so eager to get to heaven that they would abandon the children of this earth.

Not War But a Shield

A Strategic Air Command and a fleet of missiles may be a deterrent, but they are not a shield. They are a sword. It is possible to make out a rational argument against this sword. But it is impossible to make out a rational argument against a shield. A shielded nation does not in itself provoke an attack. A shield goes part of the way toward rendering nuclear attack futile—or "impossible."

There is a Bentham-style calculus in these things, the least harm for the greatest success. A military planner contemplating nuclear attack on a well-armed nuclear power must face the certainty of the massacre of large numbers of his own people, and of enormous damage to his own economy, his country's natural environment and resources, its recovery potential and military strength. Like the planner of a conventional battle, he must calculate how much of a loss he can afford to take. This is partly contingent upon how much of a loss his adversary can take—or avoid.

So that we can apply this calculus principle quickly, let us say that a Russian planner knows he must inflict relatively larger population losses on the actually smaller population of the United States. Nobody knows better than a Communist that the prime resource is human beings. In Communist countries, humans are used as draft animals. A large portion of the American population is made up of skilled and knowledgeable individuals, widely distributed—such as mechanics, engineers, doctors, scientists, etc. Unless he can be sure

of killing and crippling enough Americans, the planner finds nuclear war futile. America's recovery potential would remain greater than his. A half-obliterated American industrial complex is still bigger than a half-obliterated Russian industrial complex, and a smaller number of Americans could get more out of their complex—as they do now.

If he fails to conflict a critical population loss, the Soviet planner will have failed to eliminate the one great obstacle to Communist ambitions. At the outset of a nuclear war, he knows he would lose any real control over his satellite empire. Without the critical kill, he is not likely to get it back: the Soviet Union would remain militarily weak—relatively and absolutely—for too long. Therefore, the planner's losses would be pure waste.

Finally, the better protected the planner's victims, the larger must his effort to kill them be. How much more strain can his own economy stand in order to increase his already vast military potential? How much more denial of their needs can his own people take? Perhaps some better way, some less demanding way, to "compete" with the West can be found . . .

What Is the Alternative?

All this assumes, a rational planner. He (from Khrushchev on down) may go irrational at any time. But the only answer to this sort of irrationality is shelters.

We cannot depend on large central shelters, accessible only by beating traffic jams. Shelters must be where the people are, at home, at work, or out traveling. Public shelters are worthwhile mainly as refuges for people caught away from home, and barred from reaching home (or a co-operative or neighborhood shelter) by time and traffic, although it may be one to five hours before any fallout arrives. Such people are more likely to remain calm and use shelters at hand if they know their families can reach shelters easily. To be sure, public shelters such as President Kennedy now appears to favor could more easily be made fire-storm-proof than could the average home shelter. They would also have a degree of blast protection. And they would set standards and examples for home shelters. I realize that many serious problems are raised by a policy that seems to leave the building of shelters up to those who have the will and the wherewithal to do so, but it seems to me that these, too, are problems that cannot be solved by wishing they didn't exist.

The alternative to a steady buildup of shelter potential is a hysterical crash program in the midst of a crisis. Such a program would indeed provoke an aggressor. He might fear that our leaders had chosen war as a way out, or at least had despaired of avoiding war. Therefore, he might conclude that we *must* be planning a "first" attack. The "wisdom" of a pre-emptive attack on his own might then seem compelling. We would be caught, trowel and cement block in hand, frantic but unready.

Laymen are still prone to suggest evacuation as an alternative to shelters. For years, the government used evacuation plans as busywork to fill the gap when Congress refused to take civil-defense needs seriously. But evacuation is obviously useless if there are no fallout shelters to house the evacuees. Evacuation might also be fatally provocative, since it would have to begin several days before an attack was expected. The only "safe" conclusion an adversary might come to was that we were hoping to get in a pre-emptive attack first. This, again, might lead him to attack first.

The Price of Security

By now the reader must be feeling thoroughly depressed. The whole subject of fallout, fallout shelters, and nuclear war can only be depressing. It is painful to contemplate it for very long. It is difficult to examine the problem of survival without despairing.

The temptation to stop, to take one's ease, to live for today only, becomes enormous. No sane person is immune to this temptation, and I do not envy the President, his advisers, and the other world leaders who must face these problems all the time. The temptation crystallizes into another form: give up, admit there is no defense against nuclear horror. This crystal quickly grows another: surrender, give Khrushchev what he wants—anything to ensure that he will not hurl the bomb. But we must have learned by now that we cannot buy security at the price of freedom, in any area of our lives. There is no security without freedom.

The remedy for the poisonous temptations is to trade places with a Russian planner—with Khrushchev himself at times. This is wearying, but it has its rewards. Try it: Will you be willing to sacrifice Moscow, Leningrad, Kiev, Odessa, in order to deliver a few square miles of Berlin to Walter Ulbricht? Or would it be better to . . .

If you go far enough with this game, you discover that you have to live inside the skull of an *irrational* Communist planner, too. It is not a comfortable place.

An anti-shelter columnist recently quoted a woman who wanted no shelter because shelters imply an admission of failure in our attempts to get on with our fellow men. This woman seems to assume that we can avoid nuclear war as long as we do not fail in brotherliness. In this she displays a typically American arrogance. For the matter is not entirely within our loving American hands. "They," too, are quite capable of failing. Would anyone seriously propose that millions of children ought to die of radiation sickness as a gesture of regret for a Communist failure?

It is sad to contemplate that this nation—or any other—might ever have any need for fallout shelters. It was sad, too, that we ever needed stockades against Indians, or that the British, in 1940 needed protection against the Luftwaffe. But it is better to have these things and not need them than need them and not have them.

* * *

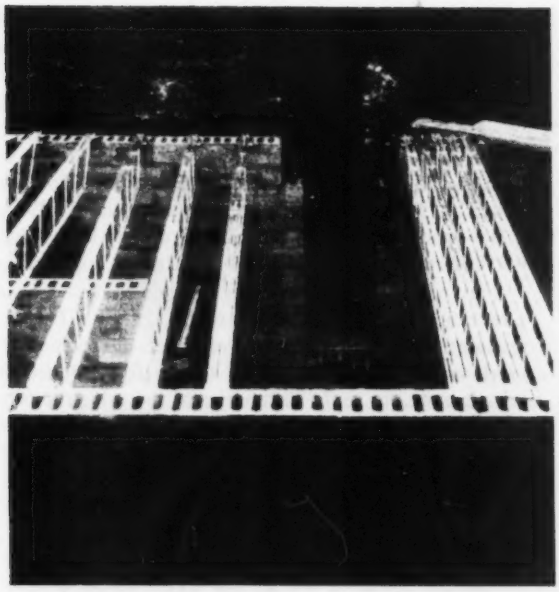


Photo 1

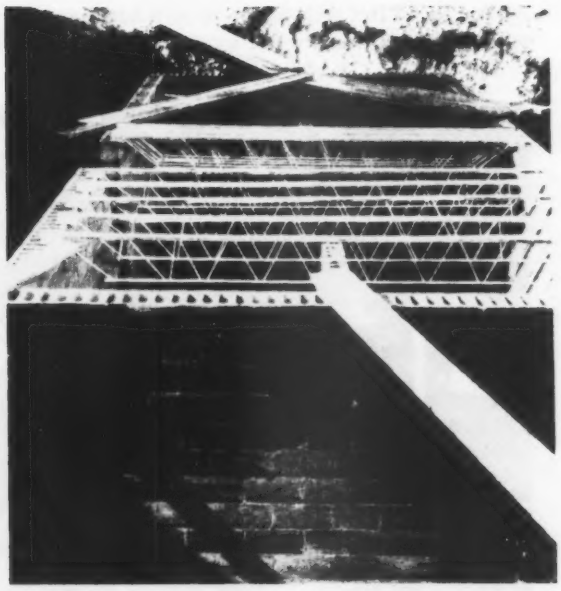


Photo 2

A Community Shelter

DESPITE statements to the contrary, a large and growing number of Canadians *are* building fallout shelters. This statement is based upon the many letters and telephone calls received each day by the federal EMO information office from citizens who have actually built their fallout shelters.

Most of those who write or telephone are seeking information about air regeneration and filtration systems, pressure valves, water containers and food storage. Some merely want to describe their shelter in detail, seeking assurance that they have not committed any technical errors during construction.

One such query produced the photographs which appear here. These photographs illustrate various stages of an underground fallout shelter built as a community effort by four Ottawa families totalling 30 persons.

The shelter is built very close to the home of one of the families and entrance is gained through the basement door as shown in photo 1. Two metal covered fire-doors seal the shelter, one at the basement entrance and the other at the shelter entrance. The passage way between was utilized to house the chemical toilet and waste containers.

The overall inside dimensions of the shelter measure

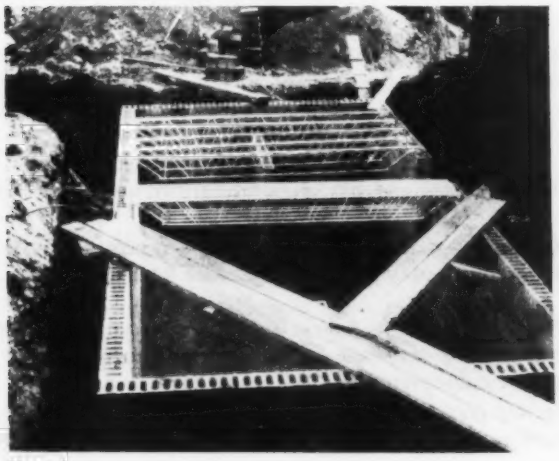


Photo 3

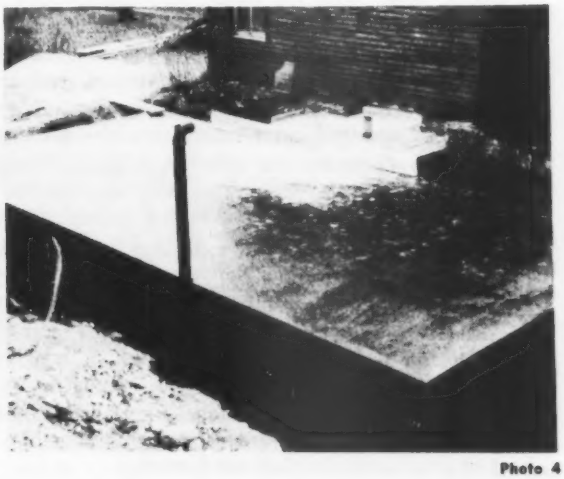


Photo 4

30 feet by 14 feet with 6 foot 10 inch headroom.

Two short dividing walls, located at each end of the shelter (see photos 1, 2 and 3) provide separate sleeping accommodation for each family and additional support for the roof girders.

Photo 5

The shelter was completed in 8 weeks and all work was sub-contracted. Following the initial excavation, which cost approximately $225.00 an 18" form was constructed and when finished the concrete floor was poured. The shelter walls are constructed of 10 inch hollow concrete blocks. These are not filled with cement nor has reinforcing steel been used in the construction.

The roof of the shelter is supported by 15 steel girders purchased at a total cost of $225.00. This cost includes the 420 square feet of sheet steel which was used to cover the girders as a base for the shelter's 5 inch concrete roof. This stage of the construction is illustrated in photos 2 and 4. When the concrete work was finished approximately 3 feet of earth was backfilled across the roof of the shelter.

These Ottawa families have stored sufficient food and fuel in their shelter to last the entire group for 30 days. Total cost of the shelter amounted to $3,500.00 or approximately $115.00 for each member of the group.

* * *

Calgary-Herald

Since the Second World War one of the most thoroughly discussed subjects, if one of the least thoroughly understood, has been radioactivity.

One of the units used to measure radioactivity is called a "roentgen" after the discoverer of the X-ray, William Konrad Roentgen, (1845-1923) the German scientist who was the first man to win a Nobel Prize in physics.

Roentgen (pronounced rent-gen) studied in Holland and Switzerland and then returned to Germany where he spent his life in prominent research and teaching posts at great universities.

It was while he was director of the Physical Institute at Wurzburg in 1895 that Roentgen began experimenting with what he later called X-rays.

Roentgen was working with vacuum tubes, testing their conduction of electricity, when he noticed that the invisible "light" from the experiments fogged photographic plates. On further experiment, the plates were fogged even when protected by heavy black paper.

Later experiments showed that this "light" could pass through other opaque substances—Roentgen's hand, for example—and still make impressions on photographic plates.

Roentgen's hand was the first ever X-rayed, and the photographic film that resulted showed the skeletal frame as doctors had never before seen it—in the living body.

This discovery not only revolutionized medicine and surgery, it has made possible great advances in metallurgy, palaeontology, archaeology and dozens of other sciences, and has given us further insight into the structure of the atom itself and helped us detect crime.

An intense man with a passion for knowledge, Roentgen was not satisfied with mere acceptance of this phenomenon he had accidentally discovered. He knew they were no ordinary rays that could pass through black paper, wood and flesh and make a photographic record.

But he did not know what kind of rays these were. That is why he called them X-rays—X being the scientific and mathematical symbol of the unknown. Although they are called X-rays even today, when their nature is understood, the science of X-rays is called "roentgenology" after their discoverer.

Roentgen won international fame for his work. He was given the Rumford Prize of the Royal Society in 1896 and in 1901 was awarded the Nobel Prize. He also did considerable research in such fields as elasticity, the heat of gases and electrical conduction.

CASUALTIES FROM NUCLEAR WEAPONS

by F. C. PACE, M.D., *Medical Consultant*
Special Weapons, Emergency Health Services

Introduction

EACH of the four products of a nuclear detonation can cause damage to human beings. Thus, the blast, by creating missiles of the flying and falling debris, gives rise to ordinary sorts of injuries. The heat flash (with, perhaps, secondary fires) causes burns. The immediate ionizing radiations, in the cases of low-yield weapons could, alone, be a threat; but this hazard, in the cases of megaton burst, is overlaid by blast and heat. The delayed, or fallout radiations, occurring when weapons are detonated at ground-level, could render wide areas of the earth's surface lethal or dangerous to the inhabitants.

Besides the actions of the products of the detonation, certain other hazards are anticipated. Some of these are exposure-effects, destruction of hygienic and sanitation systems, psychological reactions and profound sociological changes. All of these will undoubtedly involve the health professions.

Blast-Casualties

In addition to falling structures, the chief cause of blast casualties would be flying and falling debris. There would be many hundreds of missiles per square yard of vertical space. The type of injuries are those to be expected—cuts and penetrating wounds from flying glass, lacerations, crush-injuries and fractures. More injured than dead will be found toward the periphery of the target area, more dead than injured closer in.

The number of survivors may well depend on how quickly the trapped persons can be rescued—a requirement which would be made extremely difficult by the scale of massive destruction and the accompanying hazard of radiation. It seems unlikely, therefore, that there would be many survivors within the B-ring of blast.

The blast injuries present no new nor peculiar surgical problems. Rather, one must consider the "tactical" and administrative aspects of rapid collection of the injured, prompt first aid, evacuation, life-saving treatment, and important decisions related to selection of those cases most likely to benefit from early surgical attention.

In a few cases, there may be injury by "translation" —that is, where a victim is knocked down, tumbled about, or actually picked up and carried by the force of the air-blast.

Heat-Casualties

At the instant of explosion, and for a short time there-after, a flash of intense heat is given off by the weapon. Its effects on the human skin are greatly modified by cloud-conditions, humidity and other meteorological states, height of the burst, and so on. But shallow burns, or scorching of the skin, can be expected at any distance up to 25 miles from ground zero of a 5MT air burst and deep burns to distances of nine or ten miles. The effects of the heat-flash from a ground-burst weapon normally would be somewhat less.

If opaque material is interposed between the detonation and the person, the burning effect is reduced or nullified. Most types of clothing give good protection, particularly if the colour is light and the fit is loose. White fabrics reflect most of the heat, black fabrics absorb a large part of it. Some victims at Hiroshima and Nagasaki displayed bizarre burn-patterns due to their wearing multi-coloured garments, the dark parts of the clothing absorbing and transmitting the heat to the skin, the light protecting it.

Associated with the heat-flash is a blinding flash of light. Its brilliance is said to be "equal to that of several suns." Its effect is to cause temporary loss of vision due to exhaustion of the visual purple of the retina. Like the effect of flash-heat, this can be prevented and will not occur if a person is not looking toward the explosion or is in shadow.

When secondary fires occur, flame-burns must follow. One is told that many inhabitants of Hiroshima and Nagasaki perished in the flames of the great fires that followed the bombing, because injuries and rubble prevented their escape.

The surgical management of burn cases is similar to that of the ordinary injuries—nothing new in the surgical sense, but a vast problem in collection, first aid, sustaining treatment, and definitive care is presented. Considering the large numbers of injuries and

burns to be dealt with, it becomes obvious that a knowledge of simple and effective first aid by the general public is necessary. The members of no vocation nor profession are exempt from this charge.

Radiation Casualties

It is well known that the ionizing radiations are classified as immediate and residual. The immediate radiations arise from the detonating event and from the fireball which follows. These radiations consist of gamma rays and neutrons. They are of short duration (about one minute or less), they are highly penetrating, and cause the injury known as acute radiation sickness when absorbed in appreciable quantities.

The residual or delayed radiations arise from the fallout particles. Two types of emanation are given off. The one is gamma radiation (also an important constituent of the immediate radiation hazard), highly penetrating, and capable of causing acute radiation sickness. The other type is the beta particle. It is much less penetrating, and its effect is to cause damage to the body-surface. If the fallout-particles gain access to the body by any means, the component radioactive elements are capable of producing certain late effects.

The radioactive fallout, then presents three hazards:

(*a*) the external hazard due to gamma rays, causing radiation sickness;

(*b*) the contact hazard from beta particles, produces skin damage;

(*c*) the internal hazard, mainly from food and drink contaminated by the fallout, giving rise to late effects.

The relative importance of these three hazards from the fallout, and their times of appearance, are in the same order as above. Severe radiation sickness appears within hours or days and is disabling or lethal. Skin damage develops within days or weeks and the effects of radioactive material lodged within the body, (our outstanding example is strontium 90 in bone) may not appear for years. While serious, these late effects will not hamper survival operations, though defence planning must include practical measures for their prevention.

Gamma activity of fallout decreases rather quickly with time. Not so much is known of the radioactive decay of the beta component of the fallout radiations, and it is impossible to measure it satisfactorily under field conditions. Therefore, in attempting to determine acceptable levels of radiation exposure, gamma radiation only is considered by health authorities.

There is a definite association between the quantity of radiation to which an individual is exposed and the clinical reactions with follow. In military and civil defence operations, the most significant exposures are from external sources. The most important contributor to both is the penetrating gamma ray. Moreover, the whole body is exposed and not a limited part, and it is likely that the dose would be inflicted within a short space of time (one or two minutes to one or two days) in most cases.

Radiation sickness can be recognized and treated only by professional members of the Health Services. Any persons complaining of illness after exposure to radiation must be referred to a medical installation.

The only satisfactory method of controlling any type of radiation injury, is by prevention. One of the principal aims of defence planning is to afford adequate protection against the effects of gamma rays. This protection, as is now widely known, is best gained by preparation of fallout shelters in advance of attack. The Privy Council publication "Your Basement Fallout Shelter" is available to you from your provincial Emergency Measures Organization, and is worthy of serious study.

Concerning prevention of the contact hazard, early cleansing by ordinary means is the chief requirement. The ideal method is to remove all clothing, to shower and wash with copious supplies of water, detergent, and soft wash-cloths. However, it is not likely that the circumstances will permit any elaborate procedures. Hence, in most cases, the contaminated persons can reduce the contact hazard quite satisfactorily by dusting outer clothing (including shoes) and washing the scalp, face, neck and hands with water and ordinary detergent. If and when circumstances permit, a complete bath should be taken and outer clothing, at least, should be replaced.

The internal radiation hazard is most likely to arise by ingestion of contaminated water and food. Here, once more, the approach is preventive. Covered water supplies, and water from deep wells and borings, are unlikely to be soiled by the radioactive dust. On the other hand, open water supplies will receive the falling dust on their surfaces. Water stored in tins, or other closed containers, is safe for consumption after fallout has occurred, if the container itself is washed off before opening. Radiation survey techniques have been developed to establish the safety or otherwise of water supplies, in the early period after attack.

The best method of protecting food is simply to keep the dirt off. Tinned food is safe since the containers can be washed before opening. Stockpiles of tinned milk are desirable for the feeding of infants. Living food-animals and crops present special problems which are by no means insoluble; here, the veterinarian and agriculturist are valued allies of workers in human health.

It is obvious that the management of food and water after nuclear attack is a major health problem and is a subject for special study. A number of directives on these subjects have already been issued by Emergency Measures Organization, and others are forthcoming. But it must be noted that the ordinary day-to-day hazards to water and food supplies will probably be as great, or greater than, the radiological hazard, and this is a problem for the sanitarian.

Exposure Effects

It is unfortunate that little attention has been paid, as yet, to prevention of the lethal effects of cold, heat, and the exhausting circumstances of catastrophe in general. A great deal is now known about prevention of cold injuries, and of their treatment. However, techniques for their management and treatment have yet to be developed at a practical level.

Hygienic and Sanitation Hazards

This very important topic is mentioned here with emphatic brevity. It is to be expected that the ordinary, half-forgotten epidemic diseases will recrudesce in any catastrophe, in direct or geometric proportion to the magnitude of the disaster. This is one of the gravest problems facing Emergency Health Services at the moment. It cannot be successfully met, however, without widespread appreciation on the part of every community and of its leaders, for the need for simple personal hygiene and local environmental sanitation. It would be fruitless indeed to survive blast, heat, and ionizing radiations, only to die a few weeks later of typhoid or diphtheria. In Emergency Health Services Planning, comunicable disease arising of its own nature in the disturbed community and deliberate implantation of biological warfare agents by an enemy, are not too widely separated. Whatever measures for disease control that are recommended, both before and after attack, must be accepted willingly and ruthlessly enforced.

Three and a half million copies of two pamphlets were distributed to householders in the Netherlands beginning last September.

One pamphlet gave instructions on protection against nuclear attack, the other advice on first aid.

The Netherlands Government also suggested families should store specially-assembled food kits containing supplies for seven days to enable them to remain under-cover during periods of radioactive fallout. The public's response was a quiet one and there were no indications either of hysteria or uneconomic food hoarding.

In December the Netherlands Government announced plans to establish a limited number of public shelters over a period of years. Emergency evacuation and hospitalization facilities also were under study. And a pamphlet entitled "Radioactive Fallout and Agriculture" was being prepared for farmers and market gardeners.

* * *

Halifax Chronicle Herald, N.S.,
Monday, December 18, 1961.

TO THE EDITOR:

SIR:

Several letters have appeared in your paper in recent weeks ridiculing the efforts of the Civil Defence Organization and casting scorn on fallout shelters and mass training for survival.

Every generation has fought a war which it firmly believed was to end all wars but wars have continued to occur.

Must we be so vain as to be sure we can prevent another war?

We do not expect our schools to burn when we give the students fire drill. Is it not equally foolish to think that training for civil defence will increase the chance of war.

Those engaged in civil defence fear war more than the general public because they realize that madmen or mischance may suddenly begin one.

Yet the majority of them are prepared to risk their lives in rescue work if war should come.

Can anyone find any logic or reason in the thinking of those who plan to hamper rescue work by deliberately becoming casualties . . .

These people apparently lack the normal courage that might be needed to live in a world where life itself would be difficult.

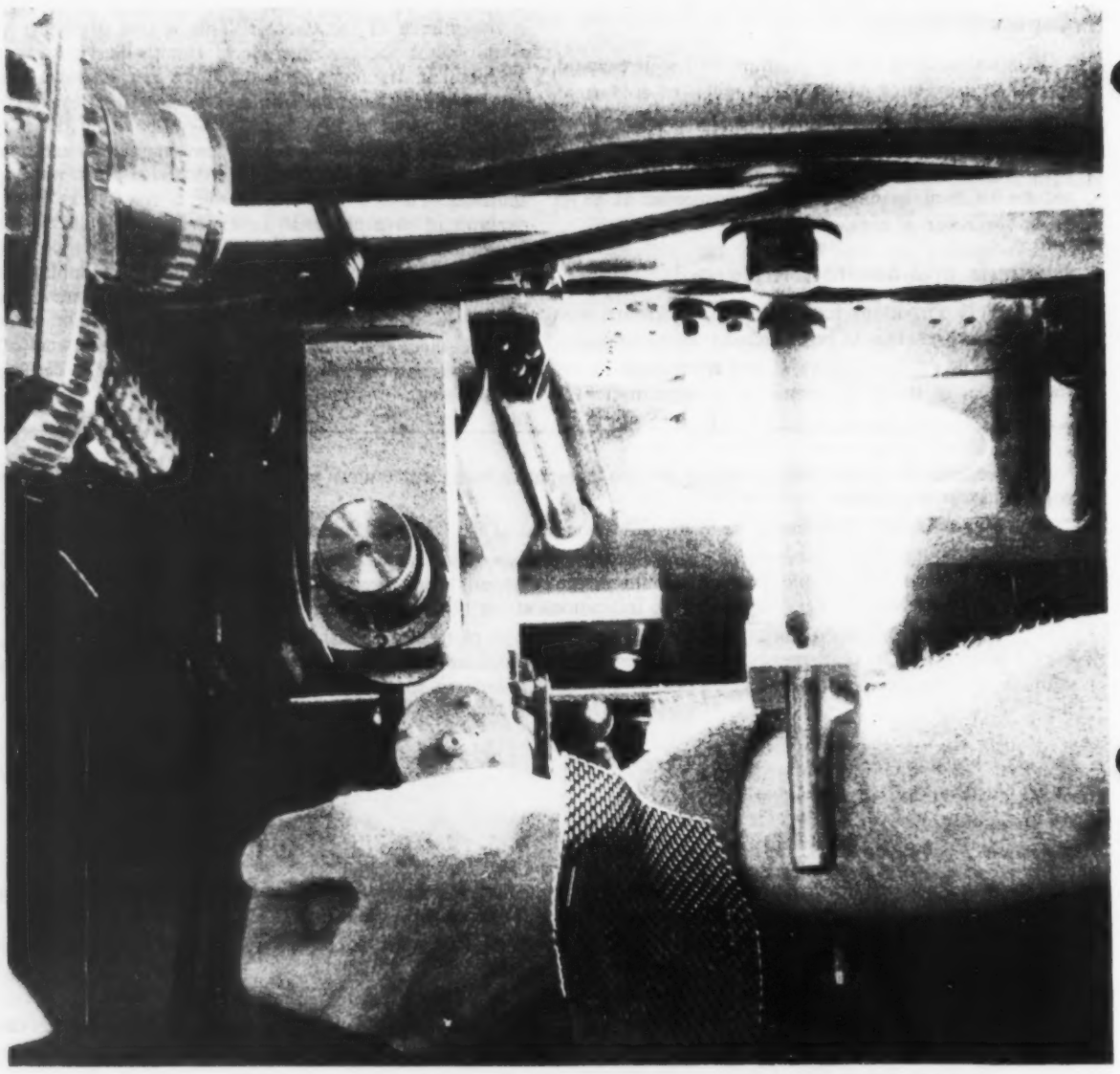
To them I can only say—your lives are not yours to throw away as you choose; it is your moral responsibility to preserve your own life and your duty to help others less fortunate than yourselves to survive.

Any person or group which has anything constructive to offer that might do away with future wars deserves our full support, once we have taken care of our own protection.

The wise man does not cancel the insurance on his home just because he supports the local fire department.

Everyone should avail themselves of the government pamphlets on survival and, until they have read them, shut their ears to the prophets of doom in our midst.

D. R. MACINNIS, M.D.,
Shubenacadie.



ATTEMPTS TO PROTECT AGAINST INTENSE HEAT FLASHES

By L. G. WILSON

Reprinted from the December 1961 issue of Professional Public Service, *the Journal of the Professional Institute of the Public Service of Canada, with permission of the publishers.*

NUCLEAR WEAPONS used in World War 2 introduced several new hazards. One of the worst was thermal radiation, because nearly one third of the total energy of each bomb was delivered as a flash of intense radiant heat, lasting a few seconds. This heat was similar to sunlight in composition but, for the Japanese bombs, was of vastly greater intensity at considerable distances from the point of bomb burst. Near this point the enormous blast effects and the effects of X and gamma rays are of predominant importance. At some distances

from ground zero, however, blast and ionizing radiation effects are reduced to a level at which thermal radiation becomes the major hazard. This distance depends on the size of the bomb, and many other variables, but a fair idea of the magnitudes involved may be given for a nominal twenty kiloton weapon, such as the Hiroshima bomb.

For such a bomb at a distance of one mile from the point of burst a man would have a fair chance of survival from ionizing radiation. At the same time he would receive thermal radiation of about thirty calories per square centimetre in a time of about one second. This energy is about one thousand five hundred times the energy of noon-day sunlight on a very clear day. For larger or smaller weapons the rate of delivery of the thermal energy is different from the figure given, but is always of such a magnitude as to be very much greater than the energy levels encountered in everyday life.

To defend personnel against these intense heat flashes is one of the projects of the Defence Research Board at its Shirley Bay laboratories. And to develop an understanding of the reaction of materials, including flesh, to such heat, studies were undertaken of the details of interactions between materials and thermal radiation. In addition, facilities were constructed at Defence Research Chemical Laboratories to enable tests of materials and ideas. These facilities took the form of a solar furnace which was capable of producing a flash of heat of the required intensity and spectral composition. With this equipment, materials could be exposed to a simulated hazard, and the results observed or photographed.

It was soon found that all normal clothing materials were very vulnerable to levels of thermal energy a lot less than those likely to be met. For example lightweight materials would be charred by about five calories per square centimetre depending on colour. But heavy dark materials soaked up the heat, and would then cause a burn to the person wearing the material after the flash was over. White or light shades of material would withstand the energy better, but would also transmit more energy, and could thus be a hazard to the wearer under some circumstances.

To develop an understanding of these various factors such as reflection and transmission of energy, another instrument was built at DRCL. In this, sunlight was received on a flat layer of the material being tested and the rate at which the heat penetrated was recorded by a very fast pen recorder. By this means it was possible to analyze the heat coming through, and find whether it was due to radiation or ordinary heat of motion. This is important for deciding whether the material is a hazard during the flash, or whether the absorbed heat is a greater hazard after the flash is over.

Attempts to provide protection for personnel took two main forms. One was to develop materials capable of withstanding the intense heat produced. All the normal textile materials such as wool, cotton and rayon are destroyed at quite low energies. Such things as asbestos immediately come to mind as possible thermally resistant fibres. But other properties of asbestos make it unsuitable for use in normal clothing. Much research has been applied to this problem, and advances have been made in producing fibres suitable for textile use far more thermally resistant than normal fibres.

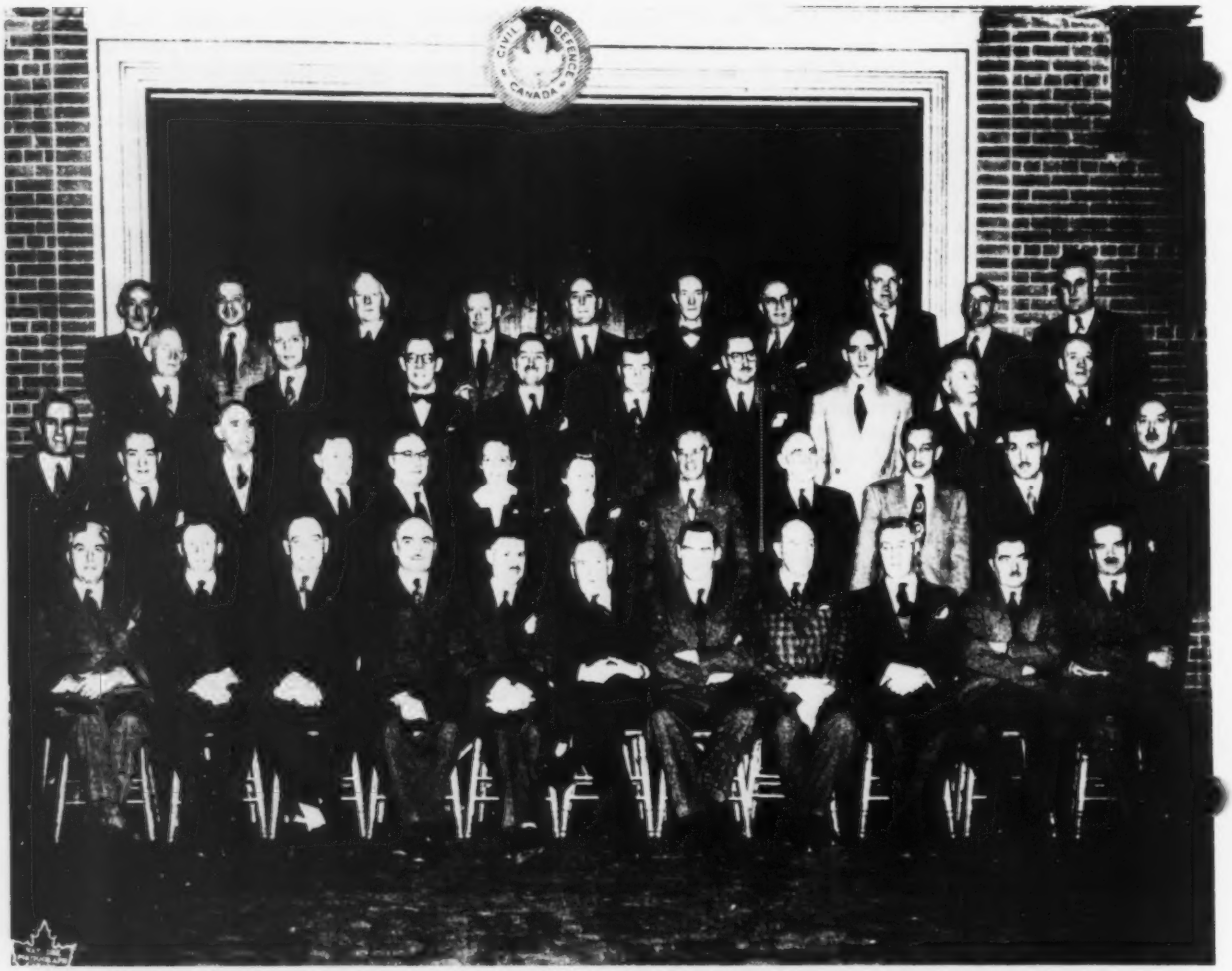
However, even if fibres could be produced capable of withstanding the white heat temperatures developed in the clothing, the problem would not be solved because the man inside the clothing would be badly burned. Some way of keeping the heat away from the man had to be found. Highly reflecting clothing, such as clean white cloth will do this, but is unsuitable for military use and in any case would be very difficult to keep white. If dirty places are present the darker dirt will absorb radiation and probably set the rest of the material on fire, thus creating a worse hazard than the original heat radiation.

At DRCL a different approach was tried. This was to intercept the incoming heat by a smoke screen thus scattering away the energy, and avoiding the formation of an extremely hot layer near the body. Such a smoke screen must be automatic in its action. It must function so rapidly that it is ready and in place within one twentieth of a second of the instant of arrival of the flash. It must be triggered by the first small fraction of the flash, and so it must be dormant until the hazard actually occurs. Other necessary properties are that the materials must be suitable for normal use, have reasonable wearing properties, and be harmless.

Such a material has been produced at DRCL and at present takes the form of a nylon net coated with a smoke-producing mix. If this net is used as an outer covering over normal clothing it intercepts a heat flash in the manner described above and prevents damage to the clothing. For example, a layer of net over a soldier's uniform will give complete protection to the clothing and the man at thirty calories per second for a one second flash. If used as a covering to otherwise bare flesh, such as the face or hands, which are not normally covered, the net will provide protection to similar levels when correctly used. It will not provide protection to the retina of the eye since its action is not fast enough. For this purpose, protection must be provided within one thousandth part of a second.

To illustrate the protection provided by the net, it is shown in the accompanying photograph during a test in the DRCL solar furnace. Here a concentrated image of the sun is flashed on the net for one second and immediately a jet of smoke spurts outwards. Both the smoke-producing net and the fabric it is protecting are in close contact with the arm of a volunteer. Such a flash at thirty calories per square centimetre for one second causes practically no damage to the cloth behind the net, and none at all to the arm. Without the net the cloth would be charred and the arm badly burned.

* * *



Canadian Civil Defence Staff Course No. 1 Held in Hull, Quebec, January-February, 1951

The above photograph, which is ten years old this month, should be of interest to many Digest readers. The Editor would welcome news from any of these members of the first Canadian Civil Defence Staff Course.

---

11 STEPS TO SURVIVAL

- KNOW THE EFFECTS OF NUCLEAR EXPLOSIONS.
- KNOW THE FACTS ABOUT RADIOACTIVE FALLOUT.
- KNOW THE WARNING SIGNALS AND HAVE A BATTERY-POWERED RADIO.
- HAVE SOME SHELTER TO GO TO.
- HAVE FOURTEEN-DAYS EMERGENCY SUPPLIES.
- KNOW HOW TO PREVENT AND FIGHT FIRES.
- KNOW FIRST AID AND HOME NURSING.
- KNOW EMERGENCY CLEANLINESS.
- KNOW HOW TO GET RID OF RADIOACTIVE DUST.
- KNOW YOUR MUNICIPAL EMERGENCY PLANS.
- HAVE A PLAN FOR YOUR FAMILY (AND IF YOU ARE ALONE, HAVE YOUR OWN PLAN.)

For a copy of the booklet "11 STEPS TO SURVIVAL." write to your local or provincial civil defence co-ordinator.

Radioactive Contamination of the Food Chain

by B. B. MIGICOVSKY

Animal Research Institute, Research Branch
Canada Department of Agriculture, Ottawa

SINCE 1945 approximately two hundred nuclear detonations have taken place. One of the results of these explosions was the injection into the stratosphere of radioactive fission products. The descent of these products to the surface of the earth constitutes fallout. Their entry into soil, plants and animals, and eventually into the human body by ingestion of contaminated plant and animal food constitutes radioactive contamination of the biosphere.

Nature of the fission products

The number of isotopes produced by a nuclear explosion are many and varied. Their significance as contaminants of the food chain depends largely on two factors: (*a*) physical half-life, which is a property of the isotope and (*b*) the biological half-life in the human body which depends on the metabolism of the isotope by the body. The important isotopes are strontium 90, strontium 89, cesium 137 and iodine 131.

Iodine 131 is of significance for a relatively short period of time after an explosion. Its physical half-life is short, about 8 days. Therefore the concentration of this isotope would reach non-significant levels within several months. Biologically it has great significance because it is concentrated in the thyroid gland and if sufficient quantity is present it will do irreparable damage. For this reason care will have to be taken to prevent consumption of iodine 131 contaminated food for several months after an explosion.

Cesium 137 has a long physical half-life and therefore would remain as a contaminant of the biosphere for a long period of time after an explosion. The danger from this isotope is mitigated in part by its relatively short biological half-life. It behaves like potassium in some respects and leaves the body quite rapidly. Nevertheless if the contamination of the food is heavy, significantly hazardous quantities could be present in our bodies so that measures will have to be taken to reduce ingestion of this isotope.

Strontium 90 and strontium 89 are the most hazardous of the isotopes, and of the two, strontium 90 is the arch villain. Strontium 90 has a long physical half-life, approximately 28 years, therefore it remains as a contaminant of the biosphere for a long time. The biological half-life is also relatively long. It enters the body via the food chain and is deposited in the bone and tends to remain there.

Attempts to increase the elimination rate of strontium 90 have been unsuccessful to date. It is important that we should be able to reduce the level of strontium 90 in our food chain so that when its concentration rises to levels higher than we wish to accept, we will be in a position to do so.

Mode of entry into the food chain

Radionuclides which enter the biosphere gain entrance into plant material via four pathways:

(1) Soil
(2) Foliar
(3) Floral
(4) Plant-base.

The strontium which enters via the soil is diluted with soil calcium. The rate of entry by this pathway is dependent on the accumulated fallout, that is, the amount that has been deposited since fallout began. The other three pathways are dependent on the rate of deposition, therefore the material that enters via the soil will be older than the material which enters the plant directly. Of all the pathways the plant-base route is the most important.

Entry of the nuclides into animal food such as meat and milk is largely via the digestive tract. In the case of strontium most of it goes into the inedible bone although a sizeable proportion enters the milk as does calcium. Cesium does not accumulate, but in its passage through the body most of it appears in the muscle and body fluids.

It is of interest to note that strontium levels relative to calcium are lower in animals than in plants, that is, the amount of strontium 90 per gram of calcium is lower in animal products. This is the case because, in the passage of calcium and strontium through the animal, strontium is discriminated against. If the cow consumes a diet in which the ratio of strontium to calcium is X, the ratio which deposits in the bone is approximately 0.25 X and the ratio in milk is approximately 0.1 X. Therefore, the animal acts as a filter for strontium. This is an extremely important fact. Because of this fact milk is the least hazardous source of calcium with respect to strontium 90 content. Also this physiological discrimination must enter into the calculations of the degree of food contamination which would be considered hazardous. This phenomenon of discrimination has been studied in detail by Comar and his co-workers, and they have formulated a means of measuring it. The

degree of discrimination is expressed by the observed ratio (O.R.) which is equivalent to

$$\frac{Sr^{90}/Ca \text{ in sample}}{Sr^{90}/Ca \text{ in precursor}}$$

For example, the sample could be the bone and the precursor the diet, therefore O.R. diet/bone would be equal to 0.25.

The fact that animal products are less contaminated than plant products with respect to strontium 90 in terms of strontium units raises an interesting agricultural problem. If we are faced with a heavily contaminated biosphere after a nuclear war we might be well advised to increase our livestock population and consume a larger proportion of animal products in our diet.

Remedial methods

What can be done to reduce the degree of contamination of our food chain? With the knowledge that we have about modes of entry an attempt can be made to interfere with the movement of isotopes at any and all stages.

If we can remove the isotopes from the soil, or render them unavailable to plants, this would decrease the contamination at the source. Since nuclides in fallout only penetrate the first five inches of soil it may be possible to decrease the uptake by removing a portion of the soil surface. Deep ploughing is another method by which we may render the nuclides at the surface unavailable. Addition of lime to soils which are low in calcium will reduce the uptake of strontium by plants. Any soil treatment is only mildly effective and when faced with the problem of treating millions of acres the task becomes quite formidable.

The inclusion of strontium-free calcium salts in the diet of animals and man will reduce the amount of strontium which enters the body. This method is of course limited by the amount of calcium that can be consumed. Nevertheless this will lower the strontium-calcium ratio to a significant extent.

The most effective method is removal of the radionuclides from the food product. Washing of plant food, removal of outer layers of material, will reduce the amount of nuclides consumed. Treatment of liquid foods in which the radionuclides are mobile is another method which can be employed. Milk lends itself to this type of treatment.

A method has been devised for treating milk with equilibrated ion exchange resins. This material can remove the isotopes of strontium, cesium and barium and leave the milk relatively unchanged with respect to composition and flavour. The resin is equilibrated with a solution of mineral salts in which the proportions of mineral elements are the same as in milk. The milk is treated with this equilibrated resin for a short time and these small quantities of strontium and cesium are taken up by the resin and exchanged for the elements of calcium, potassium, sodium and magnesium. Since the amount of strontium and cesium in milk at any time is very small there is no net change in the concentrations of the normal mineral elements present in the milk.

Further research in the treatment of food is being carried out and it is hoped that effective methods will become available. Removal of cesium 137 from meat by placing the meat in a hypertonic medium shows some promise.

A decision as to when to decontaminate food products, or when to introduce other remedial measures, will be most difficult. This decision will depend on two factors (*a*) the level of contamination in the diet and (*b*) the permissible body burden for individual nuclides and the dietary level which produces this burden. There is machinery in Canada, U.S.A., United Kingdom and other countries for a constant monitoring of the soil, water and many food stuffs which will enable the authorities to approximate the degree of contamination at any time. The selection of a suitable value for a permissible body burden is fraught with difficulty. There are many gaps in our knowledge which renders the solution of this problem extremely difficult. A number of values have been proposed and it is hoped that sober judgment combined with a thorough knowledge of the problem on the part of the authorities will lead to a suitable solution. * * *

The Digest notes with interest the publication of a new book by Léon Gouré, a senior staff member of the Social Science department of The RAND Corporation, Santa Monica, California.

Mr. Gouré's new work is entitled *Civil Defence in the Soviet Union* and is published by the University of California Press, Berkeley 4, California. Price: Cloth $4.95; Paper $2.45.